CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 22

SANITARY SEWERS

ARTICLE	TITLE
22.00	General
22.01	Related Items Specified Elsewhere
22.02	Materials A. Vitrified Clay Sewer Pipe & Joints B. Centrifugally Cast Fiberglass Mortar Pipe (CCFMP) C. Polyvinyl Chloride Pipe (PVC) D. Reinforced Concrete Pipe with Liner (RCP) E. Pressure Pipe Materials F. Other Sewer Pipe G. Manholes & Appurtenances
22.03	Excavation & Backfill
22.04	Connection to Existing Sewers A. Tap Manhole and Reshape Invert B. Connecting Dissimilar Pipe C. Temporary Sewer Plugging Requirements D. Manhole Removal and Abandonment
22.05	Pipe Installation A. Hauling, Delivery and Storage of Pipes B. Laying the Pipe C. Jointing the Pipe D. Curvilinear Alignment E. Boring, Tunneling, Directional Drilling or Jacking
22.06	Highway, Street, Railroad, and Utility Crossings
22.07	Manhole Construction A. Manhole Bottom B. Manhole Adjusting Rings C. Poured Concrete Manholes D. Precast Concrete Manhole Sections E. Cold Weather Construction
22.08	Sewer Services - Construction and Reconstruction A. General B. Construction of Sewer Services C. Reconstruction of Sewer Services

ARTICLE	TITLE
22.09	Testing A. General B. Line Acceptance Tests C. Manhole Performance Tests
22.10	Substantial Completion
22.11	Final Acceptance
22.12	Guarantee

CHAPTER 22

SANITARY SEWERS

22.00 GENERAL

The work covered in this Chapter shall include the laying and jointing of sanitary sewers and the construction of their appurtenances.

22.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 11 Portland Cement Concrete
Chapter 20 Construction for Utilities and Structures

22.02 MATERIALS

The following pipe materials are approved for use in the City of Lincoln pursuant to the specifications described herein. Developers, consultants, and contractors may request consideration of alternate pipe materials to the Director of Public Works and Utilities.

APPROVED SANITARY SEWER PIPE MATERIALS
Vitrified Clay Sewer Pipe (VCP)
Centrifugally Cast Fiberglass Mortar Pipe (CCFMP)
Polyvinyl Chloride Sewer Pipe (PVC)
Reinforced Concrete Pipe with PVC Lining (RCP)
Cured-In-Place Pipe (CIPP)

A. VITRIFIED CLAY SEWER PIPE AND JOINTS

Vitrified clay sewer pipe shall be of the best quality of hard-burned, vitrified clay or shale pipe conforming to the requirements of "Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated" ASTM Designation C-700 for extra strength pipe. Clay pipe shall be joined with factory pre-molded joints. The joints shall conform to "Specification for Compression Joints for Vitrified Clay Pipe and Fittings" ASTM Designation C-425, except that the joint gasket must be secured to one of the other joining faces prior to socketing.

B. Centrifugally Cast Fiberglass Mortar Pipe (CCFMP)

1. Pipe and Fittings
Centrifugally Cast Fiberglass Mortar Pipe (CCFMP) shall be of high quality conforming to the requirements of ASTM D2412 "Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading", ASTM D3262 "Standard Specification for Reinforced Plastic Mortar Sewer Pipe", and ASTM D3681 " Method for Determining Chemical resistance of Reinforced Thermosetting Resin Pipe in Deflected Condition." The joints shall conform to ASTM D4161 "Specification for Fiberglass (Glass-Fiber-Reinforced) Thermosetting Resin Pipe Joints Using Flexible Elastomeric Seals".

C. POLYVINYL CHLORIDE (PVC) NON-PRESSURE PIPE

1. Pipe and Fittings

PVC pipe and fittings for 15 inch and smaller sizes shall meet the requirements of "Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings" ASTM D-3034, Type PSM, SDR 35 minimum. PVC pipe and fittings for 18 inch through 27 inch sizes shall meet the requirements of "Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings" ASTM F-679, minimum wall thickness T-1. PVC pipe and fittings manufactured under "Standard Specification for Type PS-46 and Type PS-115 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings" ASTM F-789, Type PS-46 or "Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings" ASTM F-679 with T-2 wall thickness shall not be acceptable. All pipe shall be furnished in standard laying lengths. Shorter field cut lengths for curvilinear alignment may be used, provided that spigot ends are carefully cut to a perpendicular cross section and the ends beveled to permit proper jointing.

2. Joints for Pipe and Fittings

Joints for PVC non-pressure pipe and fittings shall meet the requirements of Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals" ASTM D-3212 for integral bell, single synthetic rubber gasket push-on joints. Joints using separate couplings or couplings solvent welded to one end of the pipe shall not be acceptable. Lubricants, if required, shall have no deteriorating effects on the gasket and pipe materials.

3. Manhole Water Stops

Water stops shall be required for all connections of PVC pipe with manholes. Water stops shall be of a type approved by the Project Manager, consisting of specifically manufactured synthetic elastomeric rings or boots stretched around the pipe and clamped, if applicable, with stainless steel clamps.

4. Transition Joints

Joints between PVC and other pipe materials shall be made with special transition adaptor fittings or stainless steel clamped elastomeric couplings factory fabricated specifically for the use intended and approved by the Project Manager.

D. REINFORCED CONCRETE SEWER PIPE

1. Reinforced concrete sewer pipe, 18 inch or larger, shall conform to Standard Specification for Reinforced Concrete Culvert , Storm Drain, and Sewer Pipe ASTM Designation C-76 or Standard Specification for Concrete D-Load Culvert, Storm Drain, and Sewer Pipe" C-655, as specified on the plans or Special Provisions, except as herein provided.

The coarse aggregate used in the manufacture of the pipe shall conform to the requirements of Article 11.01. The concrete used in the manufacture of the pipe shall contain at least 6 sacks of cement per cubic yard of concrete. All pipe shall not be less than 7.5 feet in length, with the exception of fittings and closure pieces and on curvilinear alignment (see Section 22.05).

D. REINFORCED CONCRETE SEWER PIPE (Continued)

2. Joints and Gaskets

Reinforced concrete sewer pipe shall be circular in cross-section with a tongue and groove joint and shall be furnished with an "O" ring-type gasket. The joints shall be capable of passing the standard infiltration/exfiltration tests as prescribed in the Standard Specifications for sanitary sewers. The gaskets shall conform to "Standard Specification for Reinforced Concrete Low-Head Pressure Pipe"ASTM C-361, Section 6.9, except minimum tensile strength shall be 1500 p.s.i. hardness shall be 40±5, maximum water absorption shall not be greater than 10%, and the polymer shall be neoprene or other synthetic rubber. Natural rubber gaskets will not be accepted. Lifting holes will not be allowed.

3. Polyvinyl Chloride (PVC) Liner

RCP for sanitary sewer shall be lined with Polyvinyl Chloride (PVC) sheet liners covering two hundred seventy degrees (270°) of the interior surface of the pipe. Liner shall be T-lock as manufactured by Ameron Protective Linings Division, Brea, California or prior approved equal.

Tensile specimens shall be prepared and tested in accordance with "Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension ASTM Designation D 412 using die B. Weight change specimens shall be 1 inch by 3 inch samples of the sheet thickness. Specimens may be taken from sheet and strip at any time prior to final acceptance of the work.

All PVC plastic liner plate sheets, joint, corner, and welding strips shall have the following physical properties when tested at 77o F +/- 10o F.

Property	**Initial**	**After Conditioning**
Tensile Strength, psi	22,000 min.	21,000 min.
Elongation at Break	200% min.	200% min.
Shore durometer, Type D	1-sec. 50-60 10-sec. 35-50	+/- 5 after 112 day @25° C +/- 3° +/- 5 initial test result
Weight Change		+/- 1.5%

Chemical Solution	Concentration
Sulfric Acid	20%
Sodium hydroxide	5%
Ammonium hydroxide	5%
Nitric Acid	1%
Ferric chloride	1%
Soap	0.1%
Detergent (linear aklyl benzyl sulfonate or LAS)	0.1%
Bacteriological	BOD not less than 700 ppm

D. REINFORCED CONCRETE SEWER PIPE (Continued)

Liner sheets shall be a minimum of 0.065 inch in thickness. Locking extension (T-shaped) of the same material as that of the liner shall be integrally extruded with the sheet. Locking extensions shall be approximately 2 ½ inches apart and shall be at lest 3/8 inch high.

All pipe shall have a two hundred seventy degree (270°) liner coverage with the longitudinal edges of the sheet butt welded. When pipe tubes are furnished, these shall be shop-welded joints. Installation of the liner, including preheating of sheets in cold weather and the welding of all joints, shall be accomplished in accordance with the manufacture's recommendations. Pipe with damaged lining which has been repaired shall be accepted only upon approval of the Project Manager.

E. PRESSURE PIPE MATERIALS

Where pressure pipe materials are required for special sanitary sewer construction, such as in cases involving minimum clearance between water mains and sanitary sewer mains, the Contractor shall use polyvinyl chloride pressure pipe as specified below. Ductile iron pipe shall only be used where specifically designated on the plans or as directed by the Project Manager to meet severe structural loading conditions.

1. Polyvinyl Chloride (PVC) Pressure Pipe

PVC pressure pipe shall be cast iron pipe size O.D., meeting the requirements of the latest revision of AWWA C900 for DR 18 (pressure rating 150 p.s.i.) pipe. Pipe shall be furnished in 20 foot standard lengths with beveled male ends and a painted ring for checking the seating depth. Joints shall be push-on type, integral bell with single synthetic elastomer gaskets.

2. Ductile Iron Pipe (DIP)

Ductile iron pipe, joints, and polyethylene encasement shall meet the applicable requirements of the same under Chapter 23 of these Specifications. All DIP shall be Class 52 minimum unless otherwise indicated on the plans.

3. Transition Joints

Joints between PVC pressure pipe or DIP and other sanitary sewer pipe materials shall be made with special transition adaptor fittings or stainless steel clamped elastomeric couplings, factory fabricated specifically for the use intended and approved by the Project Manager.

F. CURED-IN-PLACE PIPE (CIPP)

Cured-in-place pipe liners shall be fabricated from a polyester fiber belt lined on one side with polyurethane and impregnated with a liquid thermosetting resin and catalyst. The materials used shall provide a cured liner that shall be chemically resistant to municipal wastewater flows both acidic and alkaline. The tube material shall meet the requirements of "Standard Specification for Practice for Sampling for Surface Particulate Contamination by Tape Lift" ASTM Designation F 1216, Section 5.1. The resin system shall meet the requirement of "Standard Specification for Practice for Sampling for Surface Particulate Contamination by Tape Lift" ASTM Designation F 1216. The chemical resistance requirements shall conform to ASTM Designation F 1216, Appendix 2.

BASIS OF DESIGN

When submitting the Proposal and prior to opening of the bids, the Contractors shall satisfy themselves as to the proper design of the wall thickness of the liner. The contractors shall submit with their bid the design calculations for deriving the thickness(es) of the liner for each portion of the entire project. The basis of this design shall be the internal TV inspection tape provided by the City with the bidding documents. Unless otherwise approved by the City, the Contractor shall design the CIPP for a fully deteriorated condition, with no strength assigned to the existing pipe. The thickness design of the CIPP shall conform to "Standard Specification for Practice for Sampling for Surface Particulate Contamination by Tape Lift" ASTM Designation F 1216. The award of the Contract will not be made until the City has approved the Contractor's design calculation and verified total costs for the submittal. The CIPP diameter, length and wall thickness shall be appropriate for the entire reach of the project. The Contractor shall verify the actual sewer lengths and wall thickness prior to beginning work.

G. OTHER SEWER PIPE

Other sewer pipe material may be authorized only by special permission.

H. MANHOLES AND APPURTENANCES

1. Concrete

Concrete used in the construction of manholes, concrete collars, and other incidental work shall conform to the requirements of Chapter 11 of these Specifications for L3500 Concrete.

2. Brick

All brick shall be clean, hard-burned cored type brick having true shape and sharp edges for their whole length. Unless otherwise specified, all brick shall be new. Bats shall be used only to close joints, and no bats smaller than a half brick shall be used. The brick shall meet all the requirements of "Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)" ASTM Designation C-216, Type FBA, Grade SW.

3. Iron Castings

Manhole covers and frames and manhole steps shall be iron castings which shall meet all the requirements of "Specifications for Gray Iron Castings", ASTM Designation A-48, Class 30. They shall in every respect conform to Lincoln Standard Plans. Dimensions as detailed on the Lincoln Standard Plans shall deviate by no more than plus or minus 1/16 inch. All frames and covers shall be furnished with horizontal bearing surfaces machined and fitted so as to prevent any rocking in the frame when installed. No casting will be accepted that is warped, cracked, that has swells, or that has been plugged or filled.

4. Mortar

Mortar used in the construction of manholes or other appurtenant structures shall be Type S as specified in "Standard Specification for Mortar for Unit Masonry" ASTM Designation C-270. Proportions of the mixture shall conform to either of the two following alternates:

H. MANHOLES AND APPURTENANCES (Continued)

(Mixture Proportions by Volume)

Alternate	Portland Cement	Masonry Cement	Hydrated Lime or Lime Putty	Aggregate Loose & Damp
1	½	1	0	Not less than 2-1/4 nor more than 3 times the sum of the volume of the cements and lime used.
2	1	0	1/4-1/2	

5. Precast Manhole Sections, Risers, and Adjusting Rings

Precast concrete manhole sections and risers shall conform to the requirements of "Standard Specification for Precast Reinforced Concrete Manhole Sections" ASTM Designation C-478. Precast manhole base sections shall be manufactured using rubber gasket seals meeting the requirements of "Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals" ASTM Designation C-923. When adjusting manhole rim elevations less than 4 inches , the Contractor shall use brick masonry construction. When adjusting rim elevations more than 4 inches, the Contractor shall use precast concrete adjusting rings to bring the manhole cover and frame to proper grade. Precast concrete adjusting rings shall conform to "Standard Specification for Precast Reinforced Concrete Manhole Sections" ASTM Designation C-478.

6. Manhole Joints

Joints between precast manhole sections, risers, and adjusting rings shall be made using either mastic type gaskets or synthetic elastomer type gaskets. Mortar joints shall not be acceptable for manhole sections and risers. Mortar joints shall only be used in conjunction with adjusting rings and brick masonry work in bringing manhole covers and frames to proper grade.

Mastic type gasket joints shall be K.T. Snyder "Ram-Nek", Hamilton-Kent "Kent Seal No. 2", Sheller-Globe "Tac-Tite", or equal. The size of mastic type gaskets shall be as recommended by the manhole manufacturer.

Synthetic elastomer type gasket joints shall meet the same specification set forth for reinforced concrete pipe in Paragraph 22.02 D.1. of this Chapter.

I. SEWER SERVICE PIPE

Sewer service pipe for new or reconstructed sanitary sewer services shall conform to the material requirements as provided in Title 24 of the Lincoln Municipal Code.

22.03 EXCAVATION AND BACKFILL

Trench excavation, backfill, pipe bedding, and pipe foundation materials and methods shall conform to Chapter 20 of these Specifications, except as hereinafter modified for sanitary sewer construction.

Unless otherwise shown on the plans, modified by Special Provisions, or directed by the Project Manager, all plastic pipe shall be bedded with approved materials to at least 4 inches above the top of the pipe.

22.04 CONNECTION TO EXISTING SEWERS

A. TAP MANHOLE AND RECONSTRUCT INVERT

The Contractor shall make all connections to existing sanitary sewers as shown on the plans. Existing manhole bottoms shall, if necessary, be reconstructed in substantially the same manner specified below for new manhole bottoms. The manhole walls shall be reconstructed as directed by the Project Manager. No pipe less than 8 inches in diameter shall be tapped into the manhole.

BASIS OF PAYMENT

Reconstructed manholes built in conformance with these Specifications and accepted by the Project Manager shall be counted and paid for at the contract unit price bid per each for TAP MANHOLE AND RESHAPE INVERT, or for CONVERT EXISTING MANHOLE TO DROP MANHOLE. Such payment shall be full compensation for all excavation, backfill, materials, equipment, tools, labor and incidentals necessary to complete the work.

B. CONNECTING DISSIMILAR PIPE

When any dissimilar pipes are joined together, a factory-made adaptor specifically made for the purpose of connecting sewer pipes of differing materials or outside diameters shall be used to make the connection, as provided by the manufacturer's recommendations or as directed by the Project Manager. Concrete collars may also be required to prevent lateral or vertical separation at the joint. Reinforced concrete collars shall conform to the Standard Plans.

BASIS OF PAYMENT

Unless specifically designated on the Plans as extra work items for payment, factory-made adaptors, connectors, and concrete collars shall not be paid for separately. The cost of these items shall be considered subsidiary to the other items for which direct payment is made.

C. TEMPORARY SEWER PLUGGING REQUIREMENTS

The Contractor shall install plugs in the appropriate locations of all new sanitary sewers prior to, or during construction, and remove the plugs after construction using approved plugging methods and types to prevent any and all storm runoff, ground water and other foreign material from entering existing wastewater collection lines. Construction work shall not proceed until the necessary plugging has been accomplished.

Prior to line acceptance testing, any and all water and other foreign material must be removed by the Contractor from the new lines by pumping or other means approved by the Project Manager.

The Contractor shall be responsible for checking each plug daily and, if maintenance is required, shall immediately take corrective action by repairing or replacing the plugs, as applicable to the situation.

Temporary plugging during construction shall not be measured or paid for separately but shall be considered subsidiary to the items for which direct payment is made.

D. MANHOLE REMOVAL AND ABANDONMENT

Where called for on the plans, the Contractor shall plug and abandon existing sewer pipes, and either completely remove existing manholes or fill and abandon existing manholes in place. Manholes to be removed shall be totally removed from the existing location and disposed of. The tops of manholes to be filled and abandoned shall be removed, and approved material shall be compacted in the abandoned manhole to the densities required in Chapter 20.

BASIS OF PAYMENT

Plugging of existing sewer pipes shall be considered subsidiary to other items of work for which direct payment is made. REMOVE EXISTING MANHOLE, COMPLETE, shall be counted and paid for at the contract unit price bid per each. FILL AND ABANDON EXISTING MANHOLE, COMPLETE, shall be counted and paid for at the contract unit price bid per each. Such payments shall be full compensation for all excavation, backfill, materials, equipment, tools, labor and incidentals necessary to complete the work in accordance with these Specifications and as accepted by the Project Manager.

22.05 PIPE INSTALLATION

A. HAULING, DELIVERY AND STORAGE OF PIPES

The Contractor shall haul and deliver along the site all pipe, fittings, and appurtenant appliances. In all handling operations, care shall be exercised to avoid damage to the pipes and fittings.

All pipe shall be stored according to manufacturer's recommendation.

Pipes shall be moved by use of pipe slings or by hand carrying. Pipe shall be thoroughly inspected for cracks and other defects. Any pipe which, in the opinion of the Project Manager or observer, has been damaged in any way, shall be rejected and immediately removed from the job site.

B. LAYING THE PIPE

Only one type of pipe shall be used on each project unless specifically called for on the plans or authorized by the Project Manager. The laying of pipe in the finished trenches shall begin at the lowest point in the line with the spigot end laid in the direction of flow. Single pipe lengths shall be lowered into the trench in an approved manner. The pipes shall be laid to the lines and grades indicated on the plans. The line and grade of the pipe shall be controlled by methods approved by the Project Manager. The Contractor shall maintain the following tolerances from true alignment and grade:

Alignment	+/- 3 inches
Grade	+/- 1 inch

Sanitary sewer service wyes shall be located and constructed to the line and grade as indicated on the plans. Construction, marking, and plugging of service stub outs shall be in accordance with the City of Lincoln Standard Plans.

When flexible pipe is used, the Contractor shall construct and install the pipe in accordance with "Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe" ASTM Designation D 2321. Pipes should be set solidly on a firm, uniform bedding, being careful to prevent soil migration and loss of bottom and lateral support of trench boxes, so as to not disturb the pipe and the integrity of the pipe embedment zone already in place. Voids created by movement of trench boxes or supports shall be properly filled and compacted to densities specified herein. If wheel loading is used for compaction, the Contractor shall provide at least 3 feet of cover over top of pipe before beginning compaction. If a hydrohammer or vibratory plat is used, provide at least 4 feet of cover over the top of the pipe. Care shall be taken in preventing excessive point loads on pipe during backfill operations.

All pipe bells shall be in bell holes excavated for this purpose. If the bottom of the trench should, for any reason, be excavated and finished too low, it shall be refilled to the proper point with crushed rock and thoroughly compacted by mechanical tamping, as specified in Chapter 20 of these Specifications. Filling and ramming earth beneath the pipe to raise it to grade will not be permitted. Pipe shall be laid through the location where manholes are to be constructed.

C. JOINTING THE PIPE

1. General

Pipes shall be joined in an approved manner. Open ends of pipes and fittings shall be effectively sealed. When pipe laying is suspended for any reason, watertight bulkheads shall be placed at the end of the pipe.

2. Jointing Pipe

Gasketed joint pipe shall be joined in the following manner: All dirt, mud and foreign substances should be removed from the spigot and bell. Gaskets should be placed in proper position in the bell of the previously installed pipe. Lubricate gasket, bell and spigot ends with an approved lubricant. Home the pipe and check gasket with feeler gauge to ensure proper sealing. All pipe shall be joined per manufacture's recommendations.

D. CURVILINEAR ALIGNMENT

Except where otherwise authorized by the Project Manager, the recommended manufacture guidelines concerning the minimum radius of sanitary sewer pipe shall be followed.

1. Where curvilinear alignment is required using PVC sanitary sewer pipe, the method of forming curves shall be by using uniform joint deflections not to exceed one degree (1^o) per joint (unless indicated otherwise by manufacturer's information) and/or using factory-made three degree (3^o) couplings in accordance with the table below. Bending of the pipe barrel to achieve curvilinear alignment shall not be permitted.

Pipe Size Inch	Laying Length	Minimum Radius, Feet	
		1^o Jt. Defl. Alone	1^o Jt. Defl. +3^o Cpigs
8-15 (200-450)	6.25*	360	95
	12.5	720	170
	20	1150	255
18 (450)	6.25*	360	120
	12.5	720)	190
	19.5	1120	270
21, 24 (525, 600)	6.25*	345	115
	12.5	690	185
	19.5	1120	270
27 (675)	5.75*	330	115
	11.5	660	180
	19	1090	265

*Half lengths cut and beveled in the field.

Straight sections of reinforced concrete sewer pipe may be installed on curves by opening the outside of the joints in accordance with this Specification. Where reinforced concrete pipe is to be installed on radii smaller than those shown in this Specification, radius or beveled pipe may be used with prior approval of the Project Manager. On curvilinear alignments only, 4 foot and 6 foot lengths of pipe may be used on shorter radii, rather than beveled or radius pipe, at the option of the Contractor.

Reinforced concrete sewer pipe shall have a maximum joint opening of not more than ½ inch.

Pipe Diameter (Inches)	Minimum Radius (Feet) for Given Laying Lengths Using Unbeveled Pipe			
	4 Feet	6 Feet	7.5 Feet	12 Feet
18	184	276	345	552
21	212	318	397	636
24	240	360	450	720
27	268	402	502	804
30	296	444	555	888
33	324	486	607	972
36	352	528	660	1056
42	408	612	765	1224
48	464	696	870	1392
54	520	780	975	1560
60	576	864	1080	1728
66	632	948	1185	1896
71	688	1032	1290	2064
78	744	1116	1395	2232
84	800	1200	1500	2400
90	856	1284	1605	2568

E. BORING, TUNNELING, DIRECTIONAL DRILLING OR JACKING

When called for in the Contract Documents, the pipe shall be bored, tunneled, directional drilled or jacked in place in conformance with Chapter 20 of these Specifications.

F. CURED IN PLACE PIPE (CIPP)

1. General

CIPP installation shall be accomplished by inverting the resin impregnated tube into the existing sanitary sewer pipeline utilizing an inversion standpipe and hydrostatic head. Curing of the CIPP shall be accomplished by circulating hot water/steam to cure the thermosetting resin into a hard impermeable pipe. The tube shall be fabricated to a size that when installed will neatly fit the internal circumference of the sewer designated for CIPP. Allowance for circumferential stretching during insertion shall be made as per manufacturer's standards.

The length of the CIPP shall be that deemed necessary by the Contractor to effectively carry out the insertion and seal at the inlet and outlet points. When cured, the CIPP shall extend from end to end of the sewer segment being lined forming a continuous tight fitting, watertight liner.

2. Preliminary Cleaning and Inspection

Prior to CIPP installation the Contractor shall remove internal deposits and debris as necessary to assure proper liner installation. Inspection and cleaning of the pipeline shall be performed by experienced personnel trained in locating defects and determining the effectiveness of cleaning efforts. If inspection reveals an obstruction not indicated in the plans or specifications that cannot be removed by conventional methods, then the Contractor shall notify the Project Manager.

3. Installation

Prior to initiating the Work, the Contractor shall describe where the liner insertion point is located. The insertion manhole shall be inspected by the Contractor and the Project Manager to insure that sufficient and unobstructed access to the sewer line is available. Any modifications necessary at the insertion manhole shall be reviewed by the Project Manager.

The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A roller system shall be used to uniformly distribute the resin throughout the tube.

The resin impregnated liner shall be inserted through an existing manhole or other approved access by means of an inversion process which utilizes sufficient hydrostatic head to fully extend the liner to the next designated access point. The hydrostatic head shall be adjusted to be of sufficient height to hold the liner snug to the pipe wall and to produce dimples at side opening or connections.

Following liner inversion, the Contractor shall supply a suitable heat source and water recirculation to properly cure the liner. The curing equipment shall be capable of delivering hot water to the far end of the liner and to uniformly raise the water temperature in the entire liner above the temperature required to effect a cure of the resin. This temperature shall be determined by the resin/catalyst employed. The heat source and recirculation equipment shall be fitted with suitable temperature monitors to gauge the water temperature throughout the liner, water temperature entering and leaving the heat exchanger, and to determine when the exothermic reaction occurs. Initial cure shall be deemed to be completed when inspection of the exposed portions of the liner appear to be hard and sound the equipment indicates that the exothermic reaction has occurred. The cure period shall be of a duration recommended by the resin manufacturer, during which time the recirculation of the water and cycling of the heat exchanger to maintain the temperature in the tube shall be continuous.

22.05 PIPE INSTALLATION (Continued)

F. CURED IN PLACE PIPE (CIPP) (Continued)

3. Installation (Continued)

The Contractor shall cool the hardened CIPP to a temperature below 100 degrees F before relieving the static head on the liner. Cool-down may be accomplished by the introduction of cool water into the inversion tube to replace water being drained from the far end of the liner. Care shall be taken in the release of static head such that a vacuum will not develop damaging the integrity of the installed liner.

The finished CIPP shall be continuous over the entire length of an insertion run and be free from visual defects, such as foreign inclusions, dry spots, pinholes, and delamination. The CIPP shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the CIPP. If the CIPP fails to make a tight seal at any access point to terminating point, the Contractor shall repair seal with a resin mixture compatible with the CIPP. Connection to manholes and insertion through manholes shall be properly sealed by plugging any visible annular space with resin used to impregnate the liner and by utilizing non-shrink grout creating a watertight seal. Any defects that will affect, in the foreseeable future, or warranty period, the integrity or strength of the CIPP, shall be repaired at the Contractor's expense, in a manner mutually agreed by the City and the Contractor.

G. BASIS OF PAYMENT

SOLID AND COMPOSITE WALL PIPES

All pipe of the various types shall be measured and paid for at the contract unit price bid for each size per linear foot. All pipe shall be measured (center to center) through manholes. Said payment shall be full compensation for all excavations, backfill, testing, materials, equipment, tools, labor and incidentals necessary to install the pipe in a workmanlike manner acceptable to the Project Manager. Special measurement and payment for all fittings and pipe materials necessary to achieve desired radius, including beveled or radius pipe, will not be considered. The extra costs, if any, shall be merged with and considered subsidiary to the cost of the various sizes of pipe called for in the plans and in the proposal.

CURED IN PLACE PIPE

The CIPP, complete and in place, shall be measured from the inside face of the manhole on each end of the liner. Payment for the CIPP shall be made at the Contract unit price per linear foot for CIPP, IN PLACE. Such payment shall be full compensation for liner fabrication, mobilization, inserting the liner tube, expanding the liner tube, curing the liner tube, sealing the ends, by-pass pumping the normal flows, and all other materials, internal TV inspection before and after liner installation, video tape documentation, equipment, tools, labor, and incidentals necessary to complete the work called for on the plans.

22.06 HIGHWAY, STREET, RAILROAD AND UTILITY CROSSINGS

Highway, street, railroad and utility crossings shall be constructed as indicated on the plans or as specified in the Special Provisions. The City will obtain the necessary permits. Encasements shall conform to Chapter 20 of these Specifications.

In laying pressure type sewer pipe under a railroad track or over/under a water main, the center of a standard length of pipe shall be centered with the centerline of the rails or water main. (See Section 23.07 D.)

22.07 SANITARY MANHOLE CONSTRUCTION

A. MANHOLE BOTTOM

The bottom of each manhole shall be constructed of concrete or precast concrete manhole base sections, as specified in Section 22.02 herein. The manhole bottom and inverts shall be constructed as indicated in the plans. The pipe shall be adequately supported during the construction of the base.

When constructing a poured concrete manhole floor, manhole water stops shall be installed on all plastic pipes entering manhole walls. The water stop gasket shall be placed within 1 inch of the center of the manhole wall. The top of the poured manhole floor shall be as indicated on the LSP for type of sanitary manhole being constructed.

Care shall be taken to place the water stop fingers pointing toward the outside of the wall of the manhole. Water stop tightening bands shall be adjusted with socket wrenches to ensure a snug fit. Screwdriver tightening will not be acceptable.

Pipe shall be laid through manholes. The upper portion of the pipe shall be removed after other manhole construction is complete and all debris is removed from the manhole. Where plugs are required on pipe stubs, solvent weld caps shall be installed on all plastic pipe. Follow manufacture's recommendations for sealing cut sections of pipe.

Integral precast concrete manhole bottom sections are acceptable. If utilized, all pipe entrance and exit locations shall have water tight compression joints made of rubber which are integrally cast into manhole wall (A-loc or equal). The flexible joints shall meet "Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals" ASTM Designation C 923 for manufacture and meet performance and test requirements of "Standard Specification Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines" ASTM Designation C 969 or "Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure ASTM Designation C 1244. In no case, will the Contractor be allowed to construct pipe enter/exit points on new manholes by breaking out precast to the elevations and deflection angle as shown on the plans. Pipes shall not be laid through manholes when utilizing integral precast manhole base sections. Following placement of the manhole base section and insertion of pipes through manhole wall, the manhole floor and concrete fillet work shall proceed as shown on the plans.

B. MANHOLE ADJUSTING RINGS

Precast concrete grade rings may be used to adjust the manhole ring and cover to the required grade when the vertical adjustment is greater than 4 inches. At least one (1) 4 inch grade ring shall be used to allow for future adjustments. Approved mastic type gaskets shall be used to seal the joints between precast adjusting rings, the upper manhole riser, and the cast iron manhole frame (ring). The outside of the cast iron manhole frame shall be finished off with mortar as shown on the Standard Plans.

Brick adjusting rings are not allowed.

22.07 MANHOLE CONSTRUCTION (Continued)

C. POURED CONCRETE MANHOLES

The Contractor may construct concrete manholes in accordance with the Lincoln Standard Plans.

Reducing sections shall be eccentric, as indicated on the Standard Details. Cast-in-place concrete manholes shall be constructed with L3500 Concrete, as specified in Chapter 11. Forms shall have adequate bracing, be in good repair and of a manufacture approved by the Project Manager. Concrete shall be carefully placed and thoroughly consolidated to the greatest density possible. All holes, joints, or honeycombed sections shall be carefully filled and sealed with mortar.

D. PRECAST CONCRETE MANHOLE SECTIONS

Concrete manholes may also be constructed of precast sections. In the assembly of the wall sections, exercise care in the placement of gaskets to ensure watertight joints. Bottom precast sections shall be placed on top of a double ring of approved mastic type gaskets. All lift holes in precast sections shall be completely filled with an approved non-shrink grout

E. COLD WEATHER CONSTRUCTION

The Contractor shall take all reasonable precautions to protect all parts of the work from damage due to freezing or as a result of winter weather conditions. The Contractor shall cover and protect all brick and concrete masonry and shall supply artificial heat, if necessary, in order that the temperature of such masonry work shall not fall below 45^{o} degrees F for a period of at least seventy two (72) hours after the structure has been constructed.

BASIS OF PAYMENT

STANDARD MANHOLES shall be measured and paid for at the contract unit price bid per each for each type of manhole. This price shall be full compensation for the cast iron ring and cover, the brick adjustment or precast grade rings when required, the manhole floor, and all labor, tools, equipment and incidentals necessary to install these items. STANDARD MANHOLES shall also be measured from the flow line to the top of rim and paid for at the contract unit price bid per vertical foot for each type of manhole. This payment shall be full compensation for all steps, eccentric manhole sections, manhole barrel sections, drop pipes, fittings, joints, labor, materials, tools, equipment and incidentals necessary to complete each type of manhole in a manner acceptable to the Project Manager.

22.08 SEWER SERVICES - CONSTRUCTION AND RECONSTRUCTION

A. GENERAL

Where shown on the plans or as directed by the Project Manager, sewer services shall be constructed or reconstructed as necessary. All work by the Contractor on sewer service shall be performed as provided in Title 24 of the Lincoln Municipal Code (L.M.C.) and by the Lincoln Plumbing Code. These codes shall be strictly adhered to under all conditions.

All construction or reconstruction shall be made using materials approved by the Lincoln Municipal Code.

B. CONSTRUCTION OF SEWER SERVICES

Where called for on the plans, new sanitary sewer services shall be constructed under cul-de-sacs or other future paving. Generally the location will be from the location of the "Y" fitting, as shown on the plans, to a specified location on the right-of-way for adjacent properties. "Y" fittings shall be of a type compatible with the sewer main pipe being laid.

C. RECONSTRUCTION OF SEWER SERVICES

Where called for on the plans or as directed by the Project Manager, sewer services shall be reconstructed to the location of the newly constructed sewer main or to raise, lower, or realign the service to avoid conflict with the utility being constructed.

Where the reconstructed line will lie within 18 inches vertically of the utility being constructed, the line shall be cast iron soil pipe, bell end spigot, service weight or heavier; ductile iron pipe, Class 52 with polyethylene encasement; Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) ASTM D-2241 PVC pipe, Class 160, with push-on gasketed joints. All other reconstructions shall be any of the approved materials. Replacement services shall be extended to the distance from the main required to provide positive slopes. Fittings of the same material as pipe being used may be required when extreme changes in elevations or alignments are necessary.

Where new taps are deemed necessary by the Project Manager, they shall be scheduled with, and made by, the Wastewater Collection Section of the Lincoln Wastewater System.

The Contractor shall obtain all necessary tapping permits required through City Building & Safety Department. Tapping saddles, taps, and plugs for abandonment will be supplied at no additional cost to the Contractor. The Contractor will be responsible for all excavation and backfilling and supply of all other materials and labor required.

Where possible, the Project Manager may direct that the sewer service pipe be bored under existing paving or other utilities or structures.

BASIS OF PAYMENT

Measurement and payment will be made at the contract unit price bid per each for CONSTRUCT or RECONSTRUCT SEWER SERVICE. Such payment shall be full compensation for all labor, tapping permits, plumbing permit, fittings, and materials, except as otherwise provided, excavation for taps and abandonments, backfill for taps and abandonments, sod, equipment, tools and incidentals necessary to complete the reconstruction in a workmanlike manner, all as accepted by the Project Manager.

Measurement and payment will be made at the contract unit price bid per linear foot for SEWER SERVICE PIPE for each size required. Such payment shall be full compensation for furnishing and installing all pipe materials, all labor, excavation, backfill, equipment, tools, collars or connecting devices, and incidentals necessary to place the pipe in service as accepted by the Project Manager.

Boring for sewer service pipe shall be measured and paid for at the contract unit price bid per linear foot for BORING FOR SEWER SERVICE PIPE. Such payment shall be full compensation for all labor, equipment, tools, and incidentals necessary to produce the bore hole ready to receive the sewer service pipe, as accepted by the Project Manager. The pipe to be placed in the bore hole shall be paid for as provided above.

22.09 TESTING

A. GENERAL

Line acceptance tests shall be required for each section of sanitary sewer constructed between manholes or junction structures. Line acceptance tests shall consist of hydrostatic or low pressure air testing for leakage; deflection testing for all plastic pipe; and internal television inspection. In addition, all PVC pipe furnished under the Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings ASTM F-679 reference specification shall be checked to ascertain that the pipe being furnished meets the acceptable T-1 minimum wall thickness requirements. Manholes and junction structures shall also be tested for acceptable performance as hereinafter provided. Except for said T-1 wall thickness checking, the tests specified below shall not be initiated until the related backfill is compacted in place; the line, manholes, and structures have been cleaned of all interfering debris; and suitable access for necessary testing equipment is provided.

The Contractor shall furnish all labor, tools, and equipment to perform all the tests specified hereinafter and only in the presence of the Project Manager or observer, except where such tests are specifically designated as being the responsibility of the City. The methods and the equipment used for the tests shall be approved by the Project Manager. No direct payment will be made for the testing required herein. The costs associated with the testing are to be considered subsidiary to the costs of the sewer lines and manholes.

Except for pipe replacement projects where existing services must be reconnected as the new replacement pipe is being laid, or as otherwise directed by the Project Manager, live wastewater flow shall not be permitted in the sanitary sewer line until all of the following tests are completed and found acceptable. With the Project Manager's approval, dry taps to the new line may be permitted prior to testing, provided that the service line stub outs are temporarily capped off in an air-tight manner.

B. LINE ACCEPTANCE TESTS

1. Hydrostatic Tests

The following hydrostatic test may be used to meet line leakage testing requirements, or, alternately, the Contractor may at his option substitute the low pressure air testing procedure specified below. For hydrostatic testing, the maximum acceptable leakage rate shall be 0.0016 gallons per hour per lineal foot per inch) diameter. The minimum head at the upper manhole or structure shall be 5 feet more than the groundwater level surrounding the pipe. The groundwater level shall be ascertained prior to testing by connecting a clear plastic tube to the pipe nipple installed under Paragraph 22.07 A. of this chapter. The pipe nipple shall then be capped. The Contractor shall use a stand pipe not greater than 4 inches in diameter that is connected to a plug in the segment to be tested. The stand pipe shall be of sufficient length to maintain the proper test head. The test period shall be for a minimum of one (1) hour. If the leakage rate is in excess of the amount specified above, the Contractor shall make such repairs as are necessary and retest the line until these requirements are met.

The Contractor, at his option, may combine the above hydrostatic test with the exfiltration tests for the connecting manholes or structures specified in Paragraph 22.09 B. 2. hereinafter, provided that the highest test head and longest test time for the line segment and manholes in combination are met. If the combined leakage rate allowance is exceeded, the Contractor shall isolate the problem(s), make the necessary repairs, and retest the line segment and manholes separately or in combination until found acceptable.

22.09 TESTING (Continued)

2. Air Tests

Low pressure air testing may be used in lieu of hydrostatic testing specified above. The equipment shall be supplied with positive on/off valves and regulator relief valves set at no more than 8 psig for pressurizing the sewer line. The pressure gauge shall have a range of zero to ten psig, with 0.1 psig divisions and an accuracy of 0.05 psig. The pressure gauge shall have been calibrated and certified as to accuracy within the past year. The Contractor may be directed to obtain a suitable pressure gauge if for any reason the gauge on hand has questionable accuracy.

The test procedures required shall be as follows:

a. Prior to testing, the backfill shall have been placed and compaction requirements fully met, and the line shall have been cleaned of all foreign matter.

b. All equipment shall be checked for proper functioning prior to actual line testing. Use one (1) length of spare pipe laid on the ground; pressurize pneumatic plugs on each end to 25 psig; and internally pressurize the pipe to 5 psig. The plugs shall hold without bracing, and the line pressure gauge shall show no loss of air. Exercise proper safety precautions around the pressurized line in being prepared for possible blow out of the plugs.

c. After checking out all equipment, proceed with actual line testing. Insert the pneumatic plugs at each end of the test segment; extend air lines to the top of the manhole; make sure no personnel remain in the manholes; then carefully pressurize the plugs to 25 psig. Low pressure air shall be introduced into the sealed line until the internal pressure reaches 4 psig greater than the average groundwater head around the pipe (one foot of water head is equivalent to 0.433 psig). Allow at least two (2) minutes for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the air supply to the control panel shall be disconnected.

d. The portion of the line being tested shall be termed acceptable if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the equivalent average groundwater pressure that may be over the pipe) shall not be less than the time shown in the following table:

Pipe Diameter in inches	t_{min}, (Minutes)
6 (150)	2.8
8 (200)	3.8
10 (250)	4.7
12 (300)	5.7
15 (350)	7.1
18 (450)	8.5
21 (525)	9.9
24 (600)	11.3
27 (675)	12.7
30 (750)	14.2
36 (900)	17.0
42 (1050)	19.8

e. On sewers large enough to permit entry by personnel, the Contractor may air test individual joints using the same acceptance criteria as specified above, provided the equipment and procedures are first approved by the Project Manager.

3. Television Inspection

Internal television inspection of new sanitary sewers will be performed by the City on a cost per foot basis at no cost to the Contractor. The prevailing TV inspection cost can be obtained from the department of Public Works/Utilities Business Office. In most cases, television inspection will be scheduled no earlier than thirty (30) days after the installation of the pipe and shall be done at the same time and in conjunction with final deflection testing, as specified below, and after all line leakage and manhole exfiltration testing has been completed and found acceptable. Televised lines shall be termed 'acceptable' if no defects are found, such as open joints, breaks, cracks, excessive pipe deformation, intrusions, depositions and debris left in the line, or excessive vertical or horizontal misalignment. Follow-up TV inspection activities that may be required as a result of repairs to defective new sanitary sewers, will be billed as an additional cost to the Contractor at the prevailing TV inspection rate.

4. Deflection Testing

Deflection tests shall be made on all pipe installed on the project. The Contractor is encouraged to perform his own preliminary deflection testing to screen out obvious defects prior to completing other work that may later be disturbed by re-excavation to repair defects.

Final deflection testing shall not be done sooner than thirty (30) days after backfill has been compacted in place by the Contractor, unless the time limitation is expressly waived by the Project Manager. The maximum allowable deflection for any pipe shall be five percent (5%) of the base inside diameter of the pipe.

The mandrel shall be pulled through the test segment using a pulling force equivalent to hand power. The line shall be termed "acceptable" if, during final deflection testing, the mandrel passes completely through the line without restriction. In no case shall excessive force be applied in pulling the mandrel that may damage the pipe or that may erroneously indicate that deflection was within acceptable limits by temporarily expanding the pipe.

If excessive deflection is indicated, the Contractor shall make necessary repairs at his own expense and the line retested until found acceptable. No additional time waiting period shall apply for retesting following repair of the line and proper recompaction of the backfill, unless otherwise directed by the Project Manager.

On any pipe size 8" to 18" the City will perform the mandrel test, at no cost to the Contractor.

On any pipe size greater then 18", it will be the responsibility of the Contractor to perform the mandrel test with City staff in observance.

On 36" and larger diameter piping, hand testing is acceptable with an approved plan by the Project Manager and with City staff in observance.

C. MANHOLE PERFORMANCE TESTS

1. General

All manholes shall be constructed so as to be free from infiltration. The interior of the manhole shall be observed during the flushing operation for location of any deficiencies. The manhole shall also remain free from visible infiltration during the two-year period of guarantee. If any infiltration is observed during that period, the Contractor shall be required to make any necessary repairs.

2. Exfiltration Tests

Exfiltration tests shall be performed on all manholes and pipe junction structures, except where groundwater conditions do not permit proper test head levels to be achieved, as specified below. Test procedures shall be as follows:

a. Insert pneumatic plugs in all lines entering and leaving the man- hole. Extend air lines to the top of the manhole, and make sure all personnel are out of the manhole. Carefully pressurize each plug to25 psig to seal each line.

b. Fill the manhole to a level at lease 5 feet above the groundwater level surrounding the manhole, or to an 8 foot depth, whichever is higher. Allow the water to stand until maximum absorption has been reached, then refill the manhole if necessary to its original depth. If the required test head would be higher than the bottom of the frame for the manhole cover, either the exfiltration test head shall be decreased or the test waived, at the discretion of the Project Manager.

c. After the manhole has been refilled, the manhole exfiltration test shall begin and shall last for a period of at least four (4) hours. The manhole shall be considered "acceptable" if the equivalent rate of exfiltration (leakage) does not exceed 0.0016 gallons per hour per vertical foot of test head per inch diameter of the manhole. For convenience, the following table may be used to evaluate allowable leakage rate (for the cylindrical portion of the manhole only; for other structural shapes, adjust the maximum leakage rate and head drop on the basis of equivalent diameter for the same perimeter):

ALLOWABLE MANHOLE LEAKAGE RATES FOR
MANHOLE EXFILTRATION TEST

Nominal Manhole Diameter inches	Manhole Volume gal. per VF	Maximum Leakage Rate gal./ VF / hr.*	Maximum 4-Hr. Head Drop* inches
4	94	0.08	0.30
5	147	0.10	0.25
6	211	0.12	0.20

*At 8 foot test head.

C. Vacuum Testing

Vacuum testing of manholes, when used, shall be performed on all manholes and pipe junction structures to conform to the requirements of Standard Test Method for Concrete Sewer Manholes by the Negative Aire Pressure (Vacuum) Test" ASTM Designation C 1244. Test procedures shall be as follows:

a. All lift holes shall be plugged with an approved non-shrink grout.

b. All pipes entering the manhole shall be plugged, taking care to securely brace the plugs from being drawn into the manhole.

c. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendation. Top of the manhole is considered to be the top of the casting forming the manhole lid.

d. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop 9 inches of mercury. The manhole shall pass if the time is greater that the time listed in the table on the preceding page for the depth and diameter of the manhole being tested.

e. If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained.

Minimum Test Times for Various Manhole Diameters

Diameter inches									
Depth feet	30	33	36	42	48	54	60	66	72
Time- sec.									
8 (2.4)	11	12	14	17	20	23	26	29	33
10 (3.0)	14	15	18	21	25	29	33	36	41
12 (3.7)	17	18	21	25	30	35	39	43	49
14 (4.3)	20	21	25	30	35	41	46	51	57
16 (4.9)	22	24	29	34	40	46	52	56	67
18 (5.5)	25	27	32	38	45	52	59	65	73
20 (6.1)	28	30	35	42	50	53	65	72	81
22 (6.7)	31	33	39	46	55	64	72	79	89
24 (7.3)	33	36	42	51	59	64	78	87	97
26 (7.9)	36	39	46	55	64	75	85	94	105
28 (8.5)	39	42	49	59	69	81	91	101	113
30 (9.1)	42	45	53	63	74	87	98	108	121

22.10 SUBSTANTIAL COMPLETION

Sanitary sewer work shall be considered substantially complete when all pipe is laid and backfilled; all manholes are complete and backfilled; leakage testing for all pipe and manholes is complete and accepted; paving, sidewalks, and driveways are replaced; and final clean up and park space are finished.

22.11 FINAL ACCEPTANCE

The project shall be considered eligible for final acceptance by the City when all required work is complete and accepted by the Project Manager, including internal television inspection, mandrel testing of all plastic pipe, all items on plan completed, and correction of all deficiencies found as a result of testing and/or final inspection by the Project Manager. Eligibility for final acceptance shall not be delayed for more than sixty (60) calendar days past the date of substantial completion on account of the City's failure to complete internal television inspection and mandrel testing of plastic pipe because of equipment problems, scheduling conflicts, or other unforeseen circumstances attributable to the City's own responsibilities and actions.

22.12 GUARANTEE

At any time during the two year guarantee period, and within the time period allowed, the Contractor shall correct any defect in material or workmanship which has been brought to his attention. Such items shall include but not be limited to trench settlement including subsequent pavement damage, pipe leaks, and failures.